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ABSTRACT

This annotated bibliography lists instructional development resources relevant to the Interservice Procedures for Instructional Systems Development Model (ISD), a standardized model providing for the assessment of training needs; the design, development, and implementation of instruction; and the assessment of instructional quality. Following a literature search, relevant documents were classified according to the 19 block ISD model, and summaries were written to identify documents on authoring aids, procedures, or techniques. The purpose of each block in this model is defined, and documents are listed alphabetically within blocks. A status section for each block indicates the availability of authoring aids sufficient to guide an individual through all activities specified by the block, as well as the availability of relevant procedures and techniques that could be developed into authoring aids. Directions for future research, based on the lack of authoring aids available, are identified. (RAO)

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Technical Report 426

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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AN ANNOTATED BIBLIOGRAPHY FOR INSTRUCTIONAL SYSTEMS DEVELOPMENT

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Computer Based Educational Technology

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The purpose of the study was to determine the availability of "how to do it" manuals for instructional systems development. The Interservice Procedures for Instructional Systems Development Model (ISD, TRADOC Pamphlet 350-30) indicates the steps to be taken for the development and conduct of training. Authoring aids, procedures, and techniques were identified as annotated references for each block of the ISD model. Directions for a future research plan were identified based on the lack of authoring aids available.

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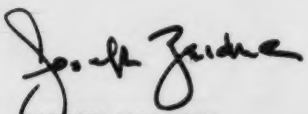
FOREWORD

The Computer-Based Educational Technology team of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) performs research and development in areas of educational technology with applicability to military education and training. Of interest are instructional delivery systems with a special focus on the development of accompanying courseware in the most efficient and cost effective manner possible. The development and implementation of such systems address the problem of training individuals who must produce good courseware in a reasonable time, at an acceptable cost.

This Technical Report provides an annotated bibliography of materials available to support instructional development. It also identifies those areas in which further research and development is required.

Appreciation is extended to Dr. Richard Braby, Department of the Navy, Training Analysis and Evaluation Group; Dr. John Ellis, Navy Personnel Research and Development Center; and Dr. J. Dexter Fletcher, Defense Advanced Research Projects Agency; for reviewing an earlier draft of this report.

The research effort is responsive to the requirements of RDT&E Project 2Q762722A764, Educational Technology and Simulation Technical Area of the FY 78 ARI Work Program.



JOSEPH ZEIDNER
Technical Director

AN ANNOTATED BIBLIOGRAPHY FOR INSTRUCTIONAL SYSTEMS DEVELOPMENT

BRIEF

Requirement:

To determine the state-of-the-art in instructional systems development and to specify critical research gaps.

Procedure:

A review of the instructional development literature was conducted. An annotated bibliography was produced which organized references according to the steps of the Interservice Procedures for Instructional Systems Development Model (ISD, TRADOC Pamphlet 350-30). Each reference was classified as (1) an authoring aid, i.e., a "how-to-do-it" manual which directly guides the author through an activity identified by the ISD model, (2) a procedure, i.e., a listing of the activities involved in ISD or (3) a technique, i.e., a methodology for accomplishing an activity but lacking sufficient detail to be a procedure.

Findings:

(1) In Phase I-ANALYZE, authoring aids are available for Select Tasks/Functions; Construct Job Performance Measures; Analyze Existing Courses; and Select Instructional Setting. Authoring aids are unavailable for Analyze Job.

(2) In Phase II-DESIGN, authoring aids are available for Develop Objectives and Develop Tests. Authoring aids are unavailable for Describe Entry Behavior and Determine Sequence and Structure.

(3) In Phase III-DEVELOP, authoring aids are available for all activities involving print as a medium. However, authoring aids are unavailable for computer-based instructional materials.

(4) In Phase IV-IMPLEMENT, authoring aids are unavailable.

(5) In Phase V-CONTROL, authoring aids are unavailable.

Utilization of Findings:

The identification of aids, procedures, or techniques will be of immediate use to those involved in instructional systems development. In addition, these findings will form one basis for a future research and development plan.

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AN ANNOTATED BIBLIOGRAPHY FOR INSTRUCTIONAL SYSTEMS DEVELOPMENT

INTRODUCTION

The need for the Instructional Systems Development (ISD) was identified in field tests of individualized instructional training systems. It was difficult to bring individuals who used these systems to the level of competence needed to produce good curriculum materials in a reasonable time at an acceptable cost. Similar difficulties have been noted with other systems employing computer-based instruction. This problem is especially acute in the Army because of the high turnover of personnel. Further, since future Army training and education systems will be individualized, the need for this technology is likely to intensify.

Currently the instructional systems development process is time consuming. It is not unusual to find that it takes one hundred or more hours to develop and evaluate one instructional hour of self-paced material. For example, Orlansky (1979) provides evidence for variability and length of time among authors to produce instructional material. His data, which summarize all available DoD studies in computer-based instruction, indicates that authors vary by a factor of 10 among themselves. In addition, several sources (e.g., Avner, 1979) have indicated that the training process takes at least six months before authors can be expected to produce useful materials and a year before full production.

The Army's first attempt at instructional systems development was called systems engineering (United States Continental Army Command Regulation 350-100-1, February 1968). The most recent effort of the Army to provide standardized procedures for the development and conduct of training is the Interservice Procedures for Instructional Systems Development Model (ISD, 1975). The model provides for the assessment of training needs; the design, development and implementation of instruction and the assessment of instructional quality through a five phase process (see Figure 1). The first phase is ANALYZE, which provides guidance on task analysis, the selection of tasks to be trained, the development of measures of job performance and the selection of the appropriate environment for training. DESIGN is the second phase which establishes the objectives, test items, and sequence of the course. The entry behavior or skills the trainee arrives with are also noted during this phase. The third phase is DEVELOPMENT during which the instructional materials are created. Existing materials are examined so that new course materials are devised only when appropriate others do not exist. A plan specifying all activities of the learner is made as well as a plan for pilot testing the newly

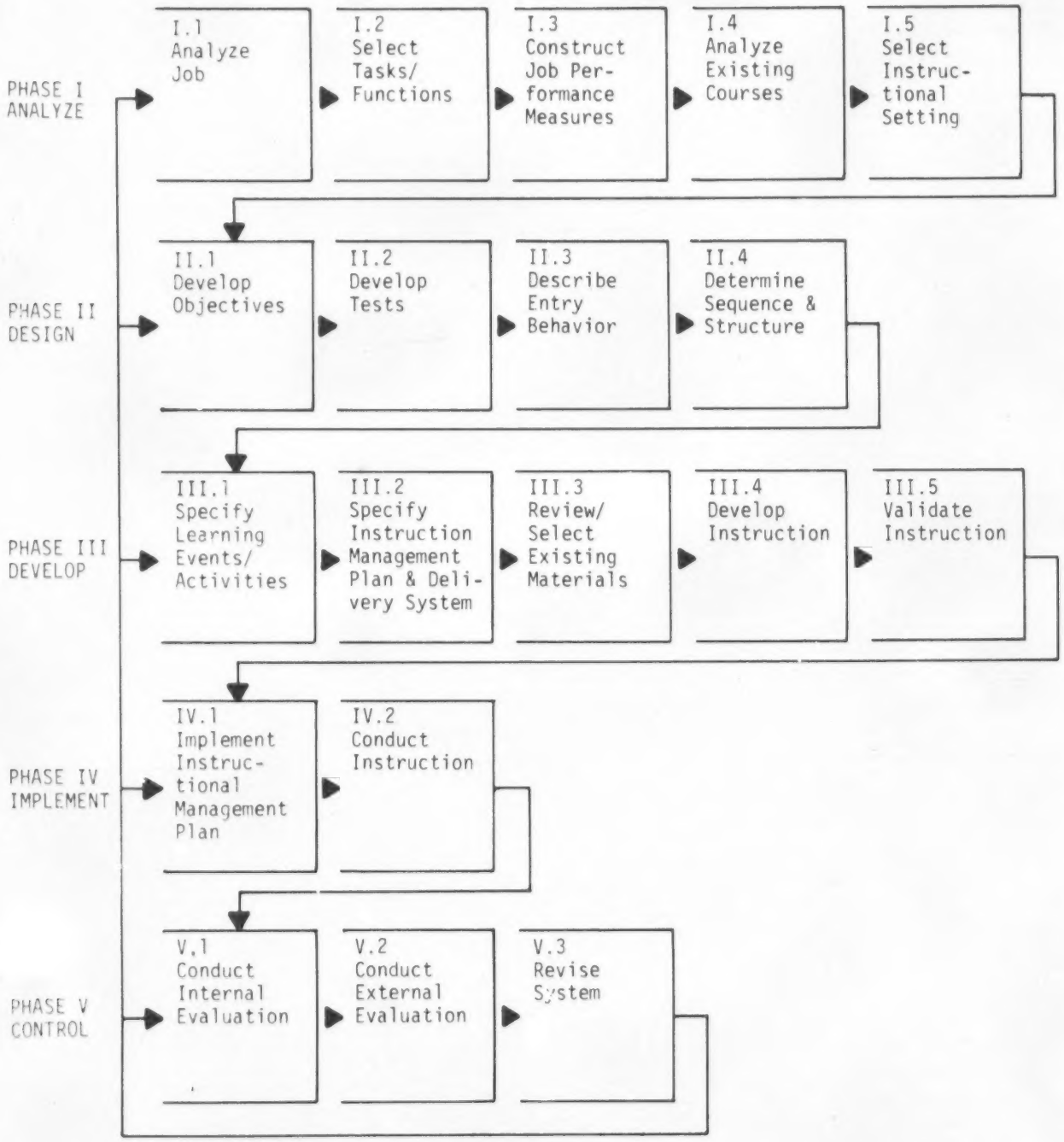


FIGURE 1. Interservice Procedures for Instructional Systems Development Model

developed materials. During IMPLEMENTATION, Phase IV, the plan of Phase III is activated with particular attention to the personnel needed to accomplish the plan. The quality of the instruction is assessed during Phase V CONTROL in terms of new skills acquired by the trainee and the fulfilled needs of the Command. As is shown in Figure 1, the five phases (identified by Roman numerals) have been elaborated upon in 19 blocks, (Arabic numbers), each with its own inputs, outputs, and feedback loop following the requirements of a systems engineering approach. A brief example on notation is Block II.1 which refers to the second phase-DESIGN and first block--Develop Objectives.

The remainder of this report will briefly discuss a problem observed with the implementation of the ISD model, provide an annotated bibliography addressing the problem and pose directions for further research and development.

PURPOSE

The activities of military instructional developers have been specified by a TRADOC Regulation (Pamphlet 350-30) which is formally known as the Interservice Procedures for Instructional Systems Development Model (ISD). This document provides "procedures" to be followed when devising a course of instruction. These procedures reflect the state-of-the-art when the model was devised. Unfortunately little guidance beyond "what needs to be done" is provided by the ISD model.

The present report was designed to review instructional development resources in an effort to provide more proceduralized guidance to individuals tasked with implementing the ISD model. These individuals are referred to as course authors. By definition authoring materials may take the form of research studies, textbooks, handbooks, computer programs, audiovisual sources, or technical manuals as long as the intention of the resource is to guide the analysis, design, development, implementation, or control of instruction. Several topics are outside the boundary conditions of this report. These include research and development related to cost-effectiveness (e.g., Seidel and Wagner, 1979) and artificial intelligence applications in instruction (e.g., Gentner, 1979).

METHOD

The present research was intended to update and supplement a previous literature review and annotated bibliography of authoring materials which was prepared and updated by Logan (1977, 1979). Many of Logan's conventions were adopted so that this report could be used in conjunction with his. However, this document includes the most cogent of Logan's references so that it is complete in itself as well. The

bibliography was formed over the course of four activities: search, classify, summarize, and assess.

A literature search, beginning with documents published in 1960, was conducted manually through the library of the U.S. Army Research Institute for the Behavioral and Social Sciences, Psychological Abstracts and abstracts from meetings of relevant professional organizations. Computer-based data searches were made with the Defense Documentation Center (DDC), the National Technical Information Center (NTIS), and the Educational Resources Information Center (ERIC). Some of the descriptors used in the search activities were:

Audiovisual Communications Media
Behavioral Objectives
Computer-Assisted Instruction
Computer-Managed Instruction
Education
Educational Program Evaluation
Individualized Instruction
Instructional Materials
Job Analysis
Systems Analysis
Task Analysis
Test Construction
Testing
Training

Documents were also made available through personal contacts with researchers and practitioners knowledgeable in instructional systems development. Copies of relevant documents were made on paper or microfiche and manually stored.

All documents were then classified according to the 19 block scheme indicated by the ISD model (see Figure 1). In some cases a document applied to more than one block. In those cases it was annotated for each block.

Next, a short summary was written after a thorough reading of each document. If a document was summarized, both authors felt it was of value. The purpose of the summary statement was to identify the document as an authoring aid, procedure, or technique. An authoring aid was defined as a "how to do it" manual which directly guides the author through an activity identified by the ISD model. A procedure was defined as a listing of the activities involved in a block of the ISD model. A technique was defined as a methodology for accomplishing an activity identified by the ISD model but lacking sufficient detail to be a procedure. Finally, the status of authoring aids and procedures available was made on a block by block basis.

In the RESULTS section which follows, the annotated bibliography is presented with a summary of the purpose of each block. The references are organized by block and then alphabetically within block. A letter preceding each reference indicates whether it is an authoring aid (A), procedure (P), or technique (T). A reference numbered A 2.4.8 identifies an authoring aid for Phase II-DESIGN, Block 4-Determine Sequence and Structure which is the eighth source. The notation in Arabic numbers identifying the source is consistent with Logan (1979).

A Status section for each block indicates the availability of authoring aids sufficient to guide an individual through all activities specified by the block as well as the availability of relevant procedures and techniques which could be developed into authoring aids. A figure indicating the availability of authoring aids, procedures, and techniques by phase and block follows, using the A, T, and P notation established earlier.

In some cases the status of a block may have indicated procedures but no techniques. It can be assumed that if a procedure exists a technique was available prior to its development. Educational Research Information Center or National Technical Information Service numbers were noted when available.

It should be noted once again that the main intention of the annotated bibliography was to identify authoring aids. The inclusion of procedures and techniques was intended to direct developmental efforts toward authoring aids.

REFERENCES

Avner, R. A. Production of Computer-based Instructional Materials. In H. F. O'Neil, Jr. (Ed.), Issues in instructional systems development. New York: Academic Press, 1979.

Gentner, D. R. Toward an Intelligent Computer Tutor. In H. F. O'Neil, Jr. (Ed.), Procedures for instructional systems development. New York: Academic Press, 1979.

Logan, R. S. A State of the Art Assessment of Instructional Systems Development. In H. F. O'Neil, Jr. (Ed.), Issues in instructional and systems development. New York: Academic Press, 1979.

Logan, R. S. A survey analysis of military computer based systems: A two part study. Volume I: A survey and annotated bibliography of aids for instructional systems development (Report No. MDC E1570). Arlington, VA: Defense Advanced Research Projects Agency, 1977. (AD 406 902)

Orlansky, J., & String, J. Cost effectiveness of computer based instruction in military training. Alexandria, VA: Institute for Defense Analysis, 1979.

Schulz, R. E., Hobbits, N., Wagner, H., & Seidel, R. J. On-line authoring aids for instructional design (Technical Paper). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, in press.

Seidel, R. J., & Wagner, H. A cost-effectiveness specification. In H. F. O'Neil, Jr. (Ed.), Procedures for instructional systems development. New York: Academic Press, 1979.

Training and Doctrine Command. Interservice procedures for instructional systems development (5 vols.) (TRADOC Pamphlet 350-30). Fort Benning, GA: Combat Arms Training Board, August 1975.

United States Continental Army Command. Systems engineering of training (CONARC Reg 350-100-1). Fort Monroe, VA: Headquarters United States Continental Army Command, February 1968.

RESULTS

AN ANNOTATED BIBLIOGRAPHY

Purpose of Block I.1 Analyze Job

To determine which activities compose a job, what level of performance is adequate, under what conditions the job is done and in what order.

References

P 1.1.1 Ammerman, H. L. Stating the tasks of the job (Vol. 2). Performance content for job training. Columbus: The Center for Vocational Education, The Ohio State University, 1977.

Procedures are given for conducting a task inventory.

P 1.1.2 Christal, R. E. The United States Air Force Occupational Research Project (AFHRL-TR-73-75). Lackland Air Force Base, TX: Air Force Human Resources Laboratory, Occupational Research Division, January 1974. (AD 774 574)

Christal reviews the development and progress of the Air Force Occupational Research Project which began in 1958. The project has produced the Comprehensive Occupational Data Analysis Programs package (CODAP). CODAP is a computer-based system which inputs, reduces, and analyzes raw data from job inventories. It also generates reports identifying individual and group job characteristics and between-job differences. It is currently used by all of the Armed Forces.

T 1.1.3 Control Data Corporation. Instructional task analysis (Pub. No. 76360712). Minneapolis, MN: Control Data Data Corporation, 1978.

This document reviews three techniques for task analysis--(1) job task analysis, (2) information-processing task analysis, and (3) hierarchical task analysis.

P 1.1.4 Folley, J. D. Jr. Development of an improved method of task analysis (Tech. Report). Vallencia, PA: Applied Science Associates, June 1964. (AD 445 869)

Folley provides a detailed procedure for task analysis indicating what information is needed and how it should be obtained and recorded.

T 1.1.5 McCormick, E. J., De Nisi, A. S. & Shaw, J. B. The use of the position analysis questionnaire (PAQ) for establishing the job component validity of tests (Report No. 5). West Lafayette, IN: Purdue University, 1977. (AD A042 270)

A research program is discussed which used the PAQ, a structured job analysis technique to establish "job component validity" of tests. The PAQ is a complicated questionnaire which enables the respondent to analyze a job in relation to 187 job elements describing job related behaviors.

P 1.1.6 Merrill, P. F. Task analysis--An information processing approach. National Society for Performance and Instruction Journal, 1976, 15(2) 7-11.

This article reviews Gagne's hierarchical task analysis procedure and presents an alternative approach--information processing analysis. Merrill suggests that two skills have an hierarchical relationship if learning one skill is prerequisite to learning the other. An information processing relationship may be observed if "the outputs of one operation are required as the inputs for another operation."

T 1.1.7 Montemerlo, M. D. & Eddowes, E. The judgmental nature of task analysis. Proceedings of the Human Factors Society Annual Meeting. Detroit, 1978.

This paper examines the state of the art of task analysis. Montemerlo and Enddowes suggest that "task analysis" defies task analysis. They use the term "proceduralizable" to characterize those tasks which can be described. Task analysis which is largely judgmental does not lend itself to proceduralization. Their argument is supported by seven factors which indicate that task analysis is an artistic, creative, synergistic, multi-purpose, problem solving, global, interpersonal, political, and cognitive task. They conclude that task analysis cannot be reduced to one specific procedure.

P 1.1.8 Powers, T. E. Selecting presentation modes according to personnel characteristics of users and the nature of job tasks, Part I job tasks. Baltimore, MD: University of Maryland, Baltimore County, July-Dec. 1977. (AD A038 511)

In this volume, Powers examines the usefulness of ten job task categories in an effort to provide a uniform procedure for classifying any job task. Seven categories were found to be highly applicable to many technical job tasks. Other volumes examine a task analysis technique which distinguishes the way technical information is presented according to personnel aptitude and category of job task.

T 1.1.9 Task Inventory Exchange. Brochure. Columbus, OH: The Center for Vocational Education, The Ohio State University, 1975.

The Task Inventory Exchange (TIE) is a national clearinghouse for occupational task inventories which are lists of job tasks. The goal of the TIE is to increase the sharing of task inventories in order to reduce duplication.

P 1.1.10 Training and Doctrine Command. Job and task analysis regulation (TRADOC Reg. 351-4). Fort Monroe, VA: Headquarters, United States Army Training and Doctrine Command, February 1979.

This document defines Army policy, objectives, procedures, and requirements for the conduct of job and task analysis. TRADOC Pamphlet 350-30 is the basis for the regulation.

P 1.1.11 Training and Doctrine Command. Job and task analysis handbook (TRADOC Pamphlet 351-4). Fort Monroe, VA: Headquarters, United States Army Training and Doctrine Command, February 1979.

The handbook details procedures for job analysis, task analysis, and the selection of tasks for training. The handbook was designed as a reference for analysts and not as a complete authoring aid to prepare trainees to perform job and task analysis procedures.

P 1.1.12 Washington State Department of Personnel. Task analysis handbook. Olympia, WA: Washington State Department of Personnel, July 1973. (PB 226 682)

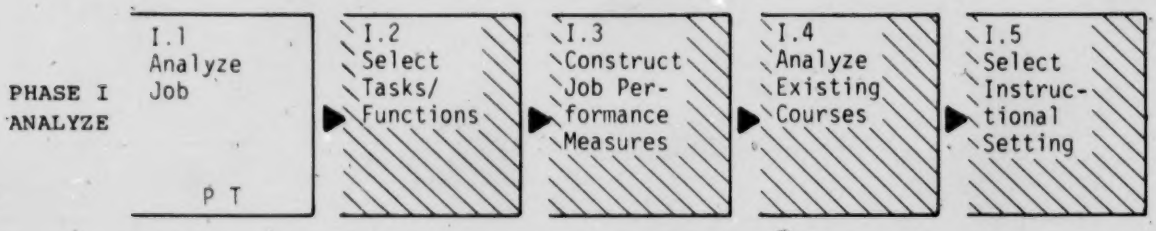
This source presents a detailed task analysis procedure for personnel analysts which includes examples of the forms task analysts use. Unfortunately it falls short of an authoring aid because it does not step a task analysis trainee through the procedures.

T 1.1.13 Yaney, J. P. A critical review of the instructional technology mechanism of task analysis. Improving Human Performance: A Research Quarterly, 1973, 3(2), 64-70.

Yaney offers a critical review of the instructional technology mechanism of task analysis. He discusses assets and liabilities of three task analysis techniques: (1) cognitive analysis, (2) master performance and (3) field analysis. Yaney presents an operational cost model for task analysis. He concludes that the costs typically outweigh the benefits.

Status

A variety of techniques and procedures exist for task and job analysis (Control Data Corporation, 1977; Ammerman, 1977; Folley, 1964; and Powers, 1977). The notion of devising an inventory of job tasks is particularly well developed. A clearinghouse for the dissemination of task inventories has been established (TIE) as well as a computer-based system (CODAP) to analyze data gathered by job inventories. The TRADOC Pamphlet (351-4) indicates the job and task analysis data which must be collected but does not provide the analyst with the rationale for making the decisions involved in gathering this data. An authoring aid for this block is unavailable.



Purpose of Block I.2 Select Tasks/Functions

To determine the tasks to be trained based upon certain selection criteria and resource availability.

References

P 1.2.1 Ammerman, H. L. Identifying relevant job performance (Vol. 3). Performance Content for Job Training. Columbus: The Center for Vocational Education, The Ohio State University, 1977. (ED 146 371)

Ammerman, H. L. & Essex, P. W. Deriving performance requirements for training (Vol. 4). Performance content for job training. Columbus: The Center for Vocational Education, The Ohio State University, 1977. (ED 146 372)

Volume 3 provides a procedure for conducting surveys to determine relevant job tasks. The details offered on the types of survey questions to be devised are useful. Volume 4 presents a task selection procedure employing prediction equations which determine the frequency of task performance.

T 1.2.2 Page, E. B., Jarjoura, D. & Konopka, C. D. Curriculum design through operations research. American Educational Research Journal, 13(1), 1976, 31-49.

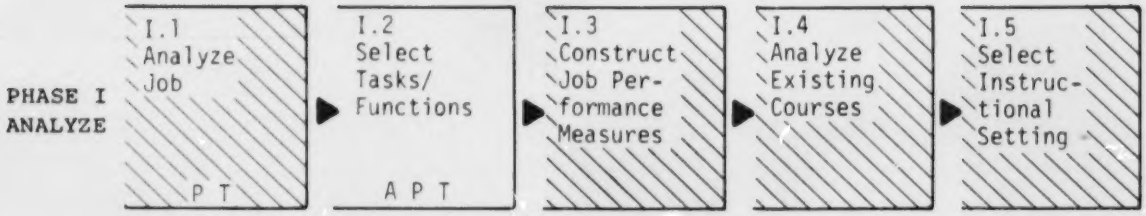
The authors present a technique which calculates values for the components involved in instructional decision making. This would make a most useful authoring aid considering the required activities of Block I.1. According to Page et al. operations research has rarely been used to determine what to teach.

A 1.2.3 Schulz, R. E. Job aid for select tasks for training (HUMRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, September 1978.

Schulz provides an authoring aid for Block I.2 following the ISD text. A system of worksheets for the collection of data, which supports selection decisions, appears to be a good technique for organizing a great deal of task analysis input.

Status

Page et al. (1976) offer a technique for selecting tasks for training. Further development could make this a useful authoring aid. Ammerman and Essex provide procedures for task selection. An authoring aid following the ISD text is offered by Schulz (1978)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I.4
Analyze
Existing
Courses
I.5
Select
Instruc-
tional
Setting

Purpose of Block I.3 Construct Job Performance Measures

To devise job performance measures (JPMs) for each task selected for training. JPMs are tests which indicate how well an individual can perform a job.

References

T 1.3.1 Ammerman, H. L. & Essex, D. W. Deriving performance requirements for training (Vol. 4). Performance content for job training. Columbus: The Center for Vocational Education, The Ohio State University, 1977. (ED 146 372)

Volume 4 provides a brief introduction to an algorithmic method for calculating level of task performance.

P 1.3.2 Gael, S. Employment test validation studies. JSAS Catalog of Selected Documents in Psychology, 1974, 4, 95. (Ms. No. 711)

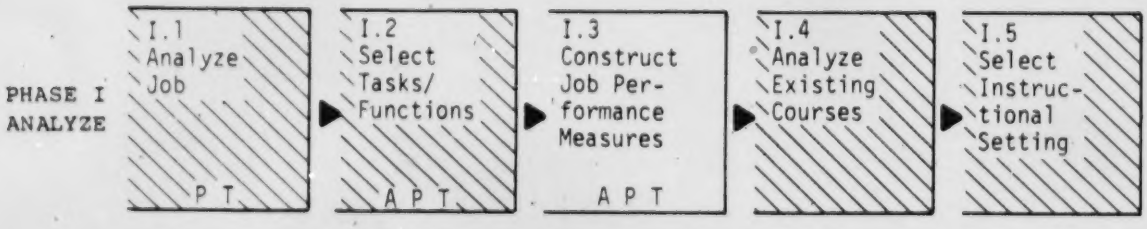
Gael discusses a procedure for the design and selection of instruments used to test clerical performance of telephone company employees.

A 1.3.3 Schulz, R. E. Job aid for conducting task analysis (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, September 1978.

Although the title differs from that of Block I.3 the activities described by this authoring aid are those of I.3. The aid provides a handbook for collecting and recording information which operationalizes each job task.

Status

A procedure exists for the development of job performance measures for clerical staff (Gael, 1974). It is reasonable to expect that this procedure could be applicable in other vocational settings. An authoring aid exists following the procedures outlined in the ISD model (Schulz, 1978).



Purpose of Block I.4 Analyze Existing Courses

To determine the degree to which a course includes the same tasks which the command needs to teach.

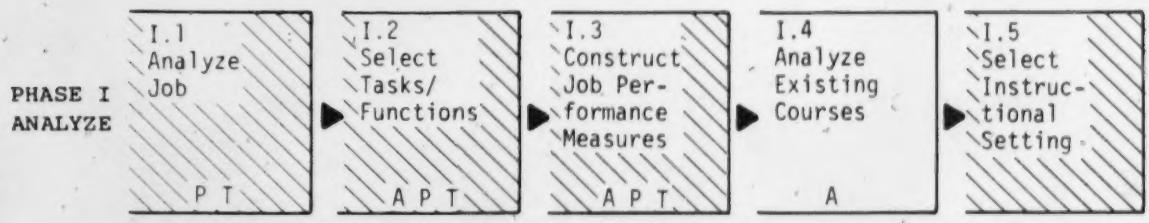
References

A 1.4.1 Schulz, R. E. Job aid for analyzing existing courses (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, September 1978.

Schulz provides an authoring aid for Block I.4 of the ISD model.

Status

An authoring aid exists for this block which was designed following the guidelines of the ISD model (Schulz, 1978). Procedures and techniques other than those specified in the ISD text itself were unavailable. A validation of the Schulz aid would be particularly valuable for determining further developmental efforts for this block.



23

Purpose of Block I.5 Select Instructional Settings

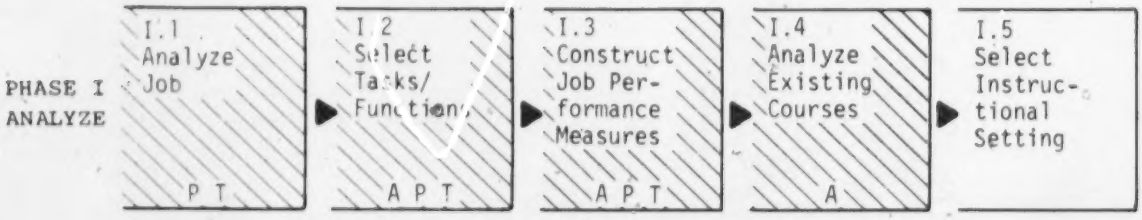
To assign tasks to one of the following instructional settings: (1) Job Performance Aids, (2) Self Teaching Exportable Packages, (3) Formal-on-the Job Training, (4) Installation Support Schools or (5) Resident Schools.

A 1.5.1 Schulz, R. E. Job aid for selecting instructional settings (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, September 1978.

Schulz provides an authoring aid which guides the trainee through Block I.5 of the ISD model.

Status

The purpose of this block is unique to military instructional settings which limits the availability of references. Schulz (1978) has developed an authoring aid covering the five settings stated in the purpose of this block. Techniques indicating the distinctions and characteristics of the five settings identified by the model and procedures for assigning tasks to all of these settings would be useful. Authoring aids following other instructional models would be of interest.



Purpose of Block II.1 Develop Objectives

To develop learning objectives for the learning categories of information mental skills, physical skills, and attitudes.

References

P 2.1.1 Gibbons, A. S. & Hughes, J. A. A method of deriving hierarchies of instructional objectives. Proceedings of the Human Factors Society Annual Meeting. Detroit, 1978.

Gibbons and Hughes offer a procedure for transforming a task list into hierarchies of instructional objectives. This document is a detailed authoring procedure which utilizes terminology of the ISD model. It would be a good candidate for an authoring aid effort.

P 2.1.2 Hillelsohn, M. J. Instructional objectives. Teaching with computers: A guide to creating instruction for computer presentation. Unpublished manuscript, 1979. (Available from Human Resources Research Organization, Alexandria, VA.)

Hillelsohn provides a procedure for devising objectives for computer-based learning. With the inclusion of opportunities for practice this document could be readily modified into an authoring aid.

T 2.1.3 Roudabush, G. E. An empirical structure for reading objectives. A paper presented at the annual meeting of the American Educational Research Association. Chicago, April 1974. (ED 095 194)

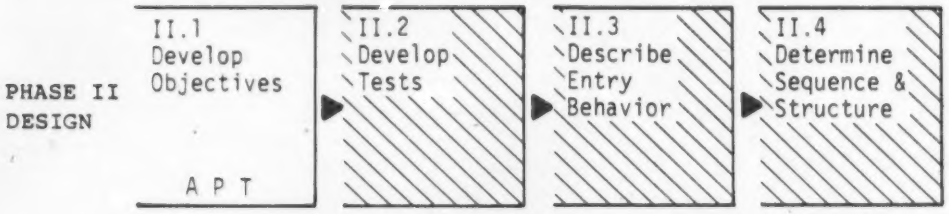
Roudabush's research examines hierarchical organizations of reading objectives. Roudabush briefly discusses instructional objective literature and provides considerable detail about reading behaviors.

A 2.1.4 Schulz, R. E. Job aid for developing objectives (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, December 1978.

This document is an authoring aid which follows the procedures outlined in Block II.1-Develop Objectives.

Status

The Gibbons and Hughes (1978) effort and the Hillelsohn (1979) effort are useful procedures for developing objectives. The latter is particularly of interest because it is a procedure for devising objectives from a task list which is the focus of this block. Both could be modified to form authoring aids. The Schulz (1978) aid follows the ISD model.



Purpose of Block II.2 Develop Tests

To write test items for each learning objective.

References

P 2.2.1 Conoley, J., & O'Neil, H. F., Jr. A primer for developing test items. In H. F. O'Neil, Jr. (Ed.), Procedures for instructional systems development. New York: Academic Press, 1979.

Conoley and O'Neil provide detailed procedures for the construction of multiple-choice test items. Guidelines for revisions are embedded in test item examples.

P 2.2.2 Gronlund, N. Preparing criterion-referenced tests for classroom instruction. New York: Macmillan, 1973.

Procedures for the development of criterion-referenced tests are provided. Gronlund discusses the decisions which must be made by the test developers--i.e., the level of mastery desired, scope of the subject matter covered, and type of test item. Also indicated are practical rules for writing test items.

P 2.2.3 Plumlee, L. B. A short guide to the development of performance tests (Professional Series Pamphlet 75-1). Washington, DC: U.S. Civil Service Commission, Test Services Section of the Personnel Research and Development Center, January 1975.

Plumlee provides an overview of a procedure for development of psychomotor tests. Task analysis, test reliability, and validity are also discussed. This source directs the reader to more detailed references.

A 2.2.4 Roid, G. & Haladyna, T. A handbook on item writing for criterion-referenced tests. San Diego, CA: Navy Personnel Research and Development Center, 1979.

Roid and Haladyna provide an authoring aid for the development of criterion-referenced tests. The authoring aid has been designed to be compatible with the ISD model.

A 2.2.5 Schulz, R. E., Hibbits, N., Wagner, H. & Seidel, R. J. On-line authoring aids for instructional design (Technical paper). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, in press.

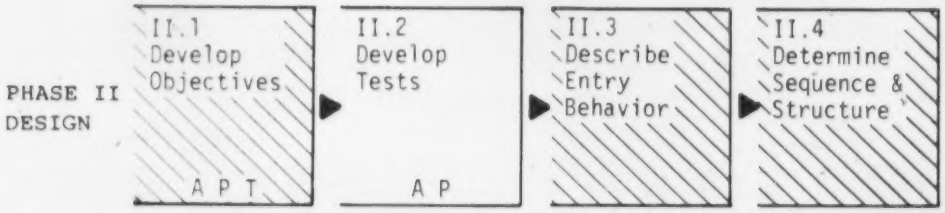
Schulz et al. provide an authoring aid for the development of test items following Block II.2 guidelines.

A 2.2.6 Swezey, R. W. & Pearlstein, R. B. Guidebook for developing criterion-referenced tests (Report No. 287-AR18(2)-IR-0974). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, August 1975. (AD A014 987)

The manual devised by Swezey and Pearlstein is a well developed authoring aid for test construction in an Army environment.

Status

Test item development is replete with procedures and authoring aids from civilian and military environments. The Roid and Haladyna (1978) handbook and the Schulz authoring aid have been designed with attention to the ISD model.



Purposes of Block II.3 Describe Entry Behavior

1. To develop and administer a test of entry skills and revise instruction according to the results.

2. To devise a pretest which measures the trainee's current knowledge so that instructional units mastered may be bypassed.

References

No references could be identified for Block II.3.

Status

The test development aspects of this block are most likely covered by procedures and authoring aids identified in Block II.2. Procedures need to be defined to identify the trainee's entry skills. Authoring aids can then be developed.

Purpose of Block II.4 Determine Sequence and Structure

To devise a learning hierarchy which specifies the sequence in which instructional objectives must be learned.

References

P 2.4.1 Airasian, P. W. A method for validating sequential instructional hierarchies. Educational Technology. December 1971, 54-56.

Airasian provides an explanation of the notion of an instructional hierarchy. He presents a model for testing the validity of an established hierarchy of instructional tasks. This procedure is needed; however, a procedure for determining the interrelationships between tasks is a higher priority which is not addressed.

T 2.4.2 Airasian, P. W. & Bart, W. M. The use of ordering theory in the identification and specification of instructional sequences. A paper presented at the annual meeting of the American Educational Research Association. Chicago, April 1974.

Airasian and Bart review a technique, which is an outgrowth of Guttman, for ordering instructional tasks. As it stands this document is too complex. A simplified version of ordering theory would be useful for an authoring aid.

T 2.4.3 Boozer, R. F. & Lindvall, C. M. An investigation of selected procedures for the development and evaluation of hierarchical curriculum structures. A paper presented at the annual meeting of the American Educational Research Association. February 1971.

A study assessing the usefulness of Guttman's scalogram analysis and simplex analysis for a mathematics program is presented. These techniques provide procedures for investigating the sequence of instruction in terms of student performance. Boozer and Lindvall affirm the value of scalogram and simplex analysis, however, this report lacks sufficient detail for the novice instructional developer.

P 2.4.4 Dansereau, D. R., Evans, S. H., Wright, A. D., Long, G. & Actkinson, T. Factors related to developing instructional information sequences: Phase I (Report No. AFHRL-TR-73-51(I)). Lowry Air Force Base, CO: Air Force Human Resources Laboratory, Technical Training Division, March 1974. (AD 777 832)

Dansereau, D. R., Evans, S. H., Actkinson, T. A., and Long, G. L. Factors relating to the development of optimal instructional sequences (Report No. AFHRL-TR-73-51(II)). Lowry Air Force Base, CO: Air Force Human Resources Laboratory, Technical Training Division, June 1974. (AD 783 843)

Phase I provides a review of instructional sequencing literature. The results of an experiment conducted in Phase II indicate that a multidimensional scaling procedure for generating instructional sequences was useful and reliable.

T 2.4.5 Dansereau, D. F., Long, G. L., Evans, S. H., & Actkinson, T. R. Objective ordering of instructional material using multidimensional scaling. Journal of Structural Learning, in press.

Dansereau et al. discuss multidimensional scaling as a technique for devising instructional sequences and the interactions of sequencing with type of material and individual differences. A good review of sequencing literature is provided but it is insufficient for a procedure or an authoring aid.

P 2.4.6 Durell, A. B. A computer simulation study of measures for validating learning hierarchies. A paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1974.

Durell examines procedures for validating a hierarchy of tasks.

P 2.4.7 Hillelsohn, M. J. Organizing instruction. Teaching with computers: A guide to creating instruction for computer presentation. Unpublished manuscript, 1979. (Available from Human Resources Research Organization, Alexandria, VA.)

A procedure for structuring and sequencing computer-based learning materials is provided.

T 2.4.8 McDade, C. E. Subsumption versus educational set: Implications for sequencing of instructional materials. Journal of Educational Psychology, 1978, 70(2), 137-141. (ED 187 983)

McDade tested two sequences of educational psychology instruction. A good review of the literature on instructional sequencing is provided.

P 2.4.9 Phillips, E. R. Development of optimal instructional sequences. A paper presented at the annual meeting of the American Educational Research Association, Chicago, April 1974. (ED 097 374)

Phillips reviews research supporting the notion that there can be an optimal sequence of instruction. Procedures for developing and valiging instructional sequences are also presented. This is a readable literature review which could supplement the ISD text.

T 2.4.10 Reigeluth, C. M. In search of a better way to organize instruction: The elaboration theory. Journal of Instructional Development, 1979, 2(3), 8-15.

Reigeluth provides a brief introduction to the elaboration model of sequencing instruction. The model suggests that instruction should be organized in a "general-to-detailed" pattern rather than a hierarchical sequence. A user's manual is in press.

T 2.4.11 Seidl, N. W. & McKeen, R. L. More on the use of student generated learning hierarchies. Improving Human Performance: A Research Quarterly, 1974 3(2), 71-80.

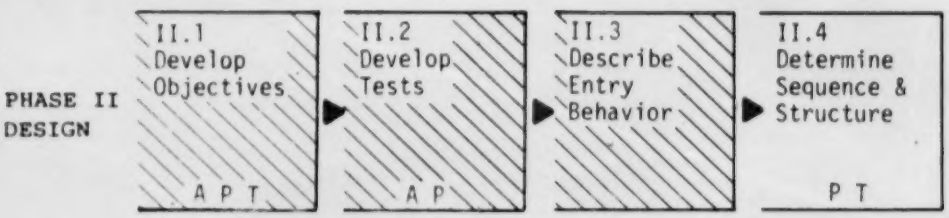
Seidl and McKeen examine learning hierarchies for algebra instruction devised by low and high ability students. Although significant results were not obtained, the notion of students devising their own learning hierarchies deserves more attention in light of current efforts to individualize instruction.

T 2.4.12 Wellens, B., Lenke, J. M. & Oswald, J. H. An investigation of a proposed hierarchy of mathematics concepts and skills using ordering theory. A paper presented at the annual meeting of the American Educational Research Association. New York City, March 1977.

The ordering theory approach to the construction of instructional hierarchies is reviewed. Wellens et al. investigated the effects of a hierarchy of mathematical skills and concepts generated by the ordering theory technique.

Status

Procedures for devising learning hierarchies exist (Dansereau et al., 1974, in press; Durell, 1974; Hillelsohn, 1979). Research studies have examined optimal sequencing of instruction (Phillips, 1974) and the development of learning hierarchies by students (Seidl and McKeen, 1974). A variety of theories exist for sequencing instruction; however, no reference approaches an authoring aid.



Purpose of Block III.1 Specify Learning Events/Activities
To classify learning objectives and identify "learning guidelines necessary for optimum learning to take place."

References

T 3.1.1 Aagard, J. A. & Braby, R. Learning guidelines and algorithms for types of training objectives (TAEG Report No. 23). Orlando, FL: Training and Analysis Group, March 1976. (AD A023 066)

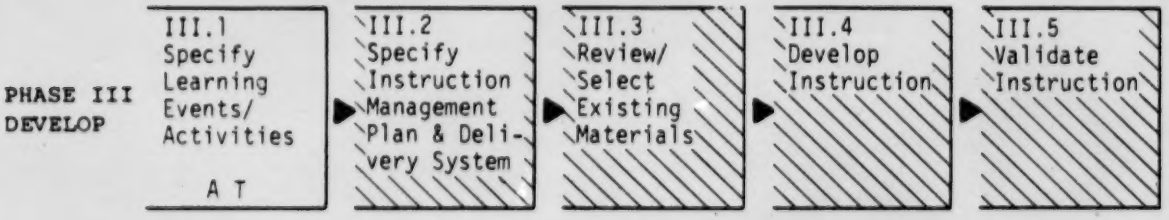
Aagard and Braby have identified 11 classes of instructional objectives (such as rule learning) and have devised a training strategy for each class. The strategies specify learning events which are compatible with the instructional objectives.

A 3.1.2 Courseware, Inc. Author training course. San Diego, CA: Courseware, Inc., January 1978. Also in H. F. O'Neil, Jr. (Ed.), Procedures for instructional systems development. New York: Academic Press, 1979.

The Author Training Course is a series of authoring aids designed to assist course authors in converting instructional objectives into instructional materials. The course follows the guidelines of the ISD model. Particular attention is paid to developing instruction which maximizes learning.

Status

The Aagard and Braby (1976) technique would make a useful authoring aid. The second reference available for this block is a course designed for course authors who are tasked with Block III.1 of the ISD model.



Purpose of Block III.2 Specify Instructional Management Plan and Delivery System

1. To specify the delivery system through media selection.

2. To prepare organizational plan for the instruction which indicates instructional activities of students and instructors.

References

P 3.2.1 Braby, R., Henry, J. M., Parrish, W. F., & Swope, W. M. A technique for choosing cost-effective instructional delivery systems (TAEG Report No. 16). Orlando, FL: Training and Analysis Group, April 1975, Revised October 1978.

The Training Effectiveness, Cost Effectiveness prediction Technique (TECEP) is a procedure designed to assist experienced training specialists in the selection of instructional delivery systems. The selection is based upon the media requirements of the training objectives and the cost-effectiveness of the various delivery systems which meet these requirements (see T 3.1.1).

P 3.2.2 Bretz, R. The selection of appropriate communication media for instruction: A guide for designers of Air Force technical training programs (Report No. R-601-PR). Santa Monica, CA: RAND Corporation, February 1971. (AD 721 443)

Bretz discusses a procedure for media selection which is based on learning objectives, course content, student characteristics, and teaching method.

T 3.2.3 Department of Defense Audiovisual Information System. A user guide for the audiovisual products data base. Arlington, VA: Office of Information for the Armed Forces, DoD Directorate for Audiovisual Activities, 1975.

This document is a user guide for a computer-based network of audio-visual products. The guide is largely concerned with the manipulation of the Hazeltine terminal which is the delivery mechanism for the system.

T 3.2.4 Keeler, F. L. & Rizzo, W. A. An evaluation of microfiche reader types for use with programmed instruction (TAEG Report No. 35). Orlando, FL: Training Analysis and Evaluation Group, August 1976. (AD A029 714)

One study compared several types of microfiche readers and indexing techniques, in an attempt to explore ease of reader usage with Navy recruits. A second study examined differences in efficiency with the use of microfiche versus traditional paper copy. No significant differences in performance were observed. The studies answered important questions concerning microfiche media but did not approach an authoring procedure or aid.

P 3.2.5 Lindahl, W. H. & Lin, B. W. An heuristic approach for the scheduling of Navy Training Courses (TAEG Report No. 52). Orlando, FL: Training Analysis and Evaluation Group, December 1977. (AD A048 183)

A procedure indicating steps and sources for scheduling Navy training sources is presented. The advantages of automated scheduling are examined.

T 3.2.6 Lonigro, J. F. & Eschenbrenner, A. J., Jr. A model for selecting the media in technical/vocational education. In H. Hitchens (Ed.), Selecting media for learning: Readings from audiovisual instruction. Washington, D.C.: Association for Educational Communications and Technology, 1974.

Lonigro and Eschenbrenner propose a model for media selection which considers types of learning required by task, desired level of mastery, matches between types of learning and media, and media production costs.

T 3.2.7 Ruefli, T. W., Ruefli, J. C., O'Neil, H., Jr., & Smith, C. M. A scheduling strategy for computer-managed instructional systems. Socio-Economic Planning Science, 1978, 12, 145-152.

Ruefli et al. describe a technique for and a test of a scheduling system for computer-managed Air Force training. The scheduling system assigns the student to the next lesson based on previous performance and computer terminal availability.

A 3.2.8 Schulz, R. E. Job aid for specifying instructional management plan and delivery system (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, January 1979.

Schulz has devised an authoring aid which guides an author through the procedures specified by Block III.2 of the ISD model.

P 3.2.9 Smith, E. H. Quality assurance of media devices and courseware (AFHRL-TR-75-37). Lowry Air Force Base, CO: Technical Training Division, Air Force Human Resources Laboratory, October 1975. (AD A018 867)

Smith presents procedures which assure quality in the development of visuals and recordings. Procedures to select cassettes and films are briefly discussed. Smith focuses on specifics of good cassette and film production.

T 3.2.10 Spangenberg, R. W. Overview of mediated courseware for learning centers (AFHRL-TR-76-37). Lowry Air Force Base, CO: Technical Training Division, Air Force Human Resources Laboratory, June 1976. (AD A033 304)

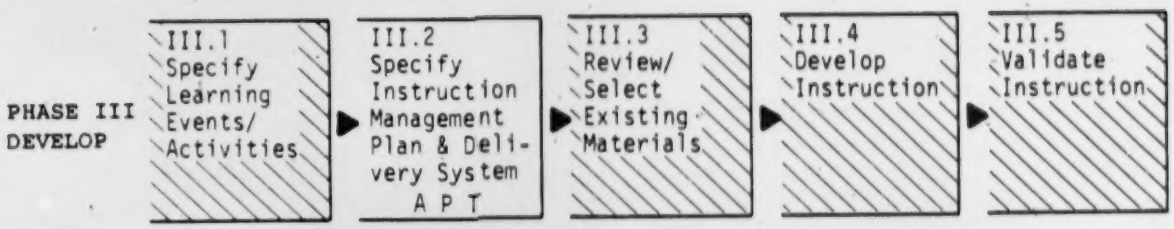
Spangenberg presents guidelines for media selection based on the type of information which is to be learned (i.e., intellectual skill, cognitive strategy, verbal information, motor skill, attitude). An effort to rewrite this document following ISD terminology would make it a useful procedure or authoring aid.

A 3.2.11 Stolovitch, H. D. Systematically selecting media: A mathematical procedure. NSPI Journal, 1977, 16(7), 11-15.

Stolovitch provides an authoring aid for devising "your own" media/media attribute matrix for media selection. A mathematical analysis of a completed matrix provides input for decision-making which incorporates (1) the range of media available and (2) the media characteristics required for attaining training goals.

Status

Procedures and techniques exist for the selection of media based on learner characteristics (Bretz, 1971) and type of learning required by the task (Lonigro & Eschenbrenner, 1974; Spangenberg, 1976; Braby et al., 1978). Several documents examine the use of different types of audiovisual media in depth including cassettes, films, and microfiche. An authoring aid exists for media selection which considers type of media and desired learning outcome (Stolovitch, 1977). Another intention of Block III.2 is to devise a schedule for the progress of instruction. A procedure and a technique exist which provide guidance on scheduling traditional and computer-based courses (Lindahl & Lin, 1971; Ruefli et al., 1978). The Schulz (1979) authoring aid covers media selection and the preparation of an organizational plan.


PHASE III
DEVELOP
III.1
Specify
Learning
Events/
Activities
III.2
Specify
Instruction
Management
Plan & Deli-
very System
A P T
III.3
Review/
Select
Existing
Materials
III.4
Develop
Instruction
III.5
Validate
Instruction

Purpose of Block III.3 Review/Select Existing Materials

To review existing instructional materials and examine the correspondence with instructional objectives of the current training need.

References

P 3.3.1 Merrill, M. D., Reigeluth, C. M. & Faust, G. W. The instructional quality profile. In H. F. O'Neil, Jr. (Ed.) Procedures for instructional system development. New York: Academic Press, 1979.

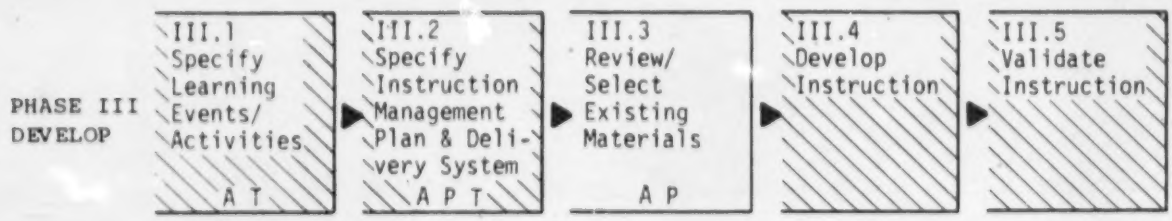
Merrill et al. discuss a procedure for diagnosing and correcting weaknesses in existing instruction through the examination of instructional objectives. An authoring aid for this procedure is in production (P 3.4.11, P 5.3.1).

A 3.3.2 Schulz, R. E. Job aid for review and selection of existing material (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, October 1978.

Schulz has prepared an authoring aid for Block III.3 of the ISD model which follows the procedurec outlined in the ISD text.

Status

The authoring aid for this block, which is now in production (P 5.3.1) will provide guidance in the analysis of existing instruction. The authoring aid provided by Schulz (1978) follows the procedures of the ISD model.



Purpose of Block III.4 Develop Instruction

To prepare new instructional materials for learning objectives which are not covered by existing materials.

References

A 3.4.1 Bell, N. T. & Abedor, A. J. Developing audio-visual instructional modules for vocational and technical training. Englewood Cliffs, NJ: Educational Technology Publications, 1977.

Bell and Abedor provide an authoring aid for the development of self-instructional audio-visual materials based on specified instructional objectives.

A 3.4.2 Braby, R., Parrish, W. F., Guitard, C. R. & Aagard, J. A. Computer-aided authoring of programmed instruction for teaching (TAEG Report No. 58). Orlando, FL: Training Analysis and Evaluation Group, June 1978.

This report describes a computer program (AUTHOR) that generates programmed training manuals which teach symbol recognition. The present document details computerized authoring system which produces a learn-package containing a pre-test, drills, and criterion tests based on author input of a set of symbols. The next two sources are companion documents to A 3.4.2 and therefore do not have reference numbers.

Guitard, C. R. Computer-aided authoring system (AUTHOR) users guide, volume I (TAEG Report No. 59). Orlando, FL: Training Analysis and Evaluation Group. June 1978.

This document is an operator's manual which accompanies the previous reference. It also lists the computer program for AUTHOR which assists in the preparation of training materials.

Braby, R. Computer-aided authoring of instructional materials (Tech. Note 2-79). Orlando, FL: Training Analysis and Evaluation Group, June 1978.

Braby reviews the computer-aided authoring technique presented in TAEG Reports No. 58 and 59. He also reports that materials produced by computer-aided authoring routines were found to produce performance superior to those using traditionally developed materials.

A 3.4.3 Braby, R., Kincaid, J. P., & Aagard, J. A. Use of mnemonics in training materials: A guide for technical writers (TAEG Report No. 60). Orlando, FL: Training Analysis and Evaluation Group, July 1978.

Braby et al. provide an authoring aid for writing mnemonics (memory aids to be included in training materials for classroom instruction. Nine mnemonic techniques are reviewed and details on when each technique should be used are given. The following document is a companion document to A 3.4.3.

Ainsworth, J. S. Symbol learning in Navy technical training (TAEG Report No. 66). Orlando, FL: Training Analysis and Evaluation Group, January 1979.

This report is an evaluation of the technique developed by TAEG for writing mnemonics (Report No. 60) for symbol learning and a feasibility demonstration of the computer-based authoring system (A 3.4.2). Handbooks produced by the computer-aided authoring routines were found to be desirable as well as the complete algorithm for symbol learning during morse code training.

A 3.4.4 Courseware, Inc. Author training course (Data Item No. 0002AD). San Diego, CA: Courseware, Inc., January 1978. Also in H. F. O'Neil, Jr. (Ed.), Procedures for instructional systems development. New York: Academic Press, 1979.

The Author Training Course is a series of authoring aids designed to guide course authors through Block III.4 of the ISD model (A 3.1.2). The goal of the course is to have authors develop instruction for specified instructional objectives.

A 3.4.5 Deterline, W. A. & Lenn, P. D. Coordinated instructional systems. Palo Alto, CA: Sound Education, 1972.

This is a lesson book which forms a self study course on instructional design. The book is a thorough authoring aid which guides the author through the development of two lessons. Deterline and Lenn indicate the time needed to reach mastery in their course of instructional design is an average of 35 hours.

P 3.4.6 Hillelsohn, M. J. Production of CBLM. Teaching with computers: A guide to creating instruction for computer presentation. Unpublished manuscript, 1979. (Available from Human Resources Research Organization, Alexandria, VA.)

Hillelsohn presents a procedure for putting instructional materials into a computer system. The steps involved in programming, inputting, and debugging the system are detailed.

P 3.4.7 Joyce, R. P., Cheznoff, A. P., Mulligan, J. F. & Mallory, W. J. Fully proceduralized job performance aids: Handbook for JPA developers (Tech. Report). Vallencia, PA: Applied Science Associates, December 1973.

Joyce, R. P., Cheznoff, A. P., Mulligan, J. F. & Mallory, W. J. Fully proceduralized job performance aids: Handbook for JPA managers and training specialists (Tech. Report). Vallencia, PA: Applied Science Associates, December 1973. (AD 775 706)

Joyce et al. provide detailed procedures for the development of Job Guides and Troubleshooting Aids for Air Force equipment maintenance. The development of this information into an authoring aid would give input for those tasked with Job Performance Aid development.

A 3.4.8 Kern, R. P., Sticht, T. G., Welty, D. & Hauke, R. N. Guidebook for the development of Army training literature. Alexandria, VA: Human Resources Research Organization, November 1976. (AD A033 935)

This document is an authoring aid for the development of training manuals. The guide presents examples of training manual problems in a "before and after revision" format.

A 3.4.9 Schulz, R. E., Hibbits, N., Wagner, H. & Seidel, R. J. On-line authoring aids for instructional design (Technical paper). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences, in press.

An authoring aid is provided for Block III.4 of the ISD manual.

A 3.4.10 Shriver, E. L. Fully proceduralized job performance aids: guidance for performing behavioral analyses of tasks (AFHRL-TR-75-38). Lackland Air Force Base, TX: Air Force Human Resources Laboratory, Occupational Research Division, June 1975. (AD A015 059)

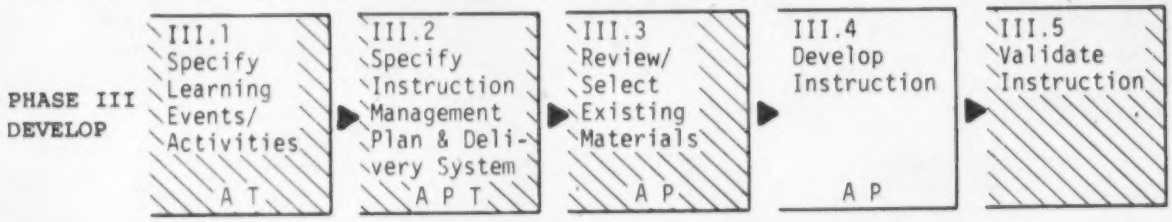
Shriver amends the Joyce et al. (see P 3.4.7) documents with finer details for job performance aid development.

P 3.4.11 Wulfeck, W. H., Ellis, J. A., Richards, R. E., Wood, N. E. & Merrill, M. D. The instructional quality inventory: I. Introduction and overview (Special Report No. 79-3). San Diego, CA: Navy Personnel Research and Development Center, November 1978.

The Instructional Quality Index (IQI) is a procedure for the development of instruction based on the learning behaviors and outcomes specified by the instructional objectives. Authoring aids for the IQI are in preparation. The IQI was originally called the Instructional Strategy Diagnostic Profile (ISDP) (P 3.3.1, P 5.3:1).

Status

This block is the best developed in terms of the availability of authoring aids for print and audio-visual using the ISD model (Courseware, 1978; Schulz et al., 1977; Wulfeck et al., 1978; Braby et al. 1978) perhaps because it is the most basic to the intent of the model. Authoring aids are available for the programming (Hillelsohn, in press) and are unavailable for the development of computer-based instructional materials.



Purpose of Block III.5 Validate Instruction

To debug instructional materials by trial with students.

References

P 3.5.1 Dick, W. Applications of formative evaluation to the instructional design process. A paper presented at the annual meeting of the American Educational Research Association. New York City, April 1977. (ED 132 135)

Dick reviews procedures for formative evaluation which must be part of an instructional development plan so that evaluative information is gathered during each phase of the developmental process.

P 3.5.2 Kandaswamy, S., Stolovitch, H. D. & Thiagarajan, S. Learner verification and revision: An experimental comparison of two methods. AV Communication Review, 1976, 24(3), 316-328.

Kandaswamy et al. examined the cost effectiveness of two procedures for testing instructional materials on students and making revisions based on their feedback. Instructional materials can be piloted with one student or with a group of students. Their research findings indicated no significant difference. These results indicate that the more cost effective method would be trials with one student at a time.

T 3.5.3 Rayner, G. T. An empirical study of a methodology for the revision of systematically designed educational materials (CAI Center Tech Report No. 24). Tallahassee, FL: Florida State University, March 1972. (ED 067 877)

Rayner developed and tested a model which identified revisions for instructional materials based on content and procedural deficiencies. The model was found to be empirically useful for revising a health education course. (See Block V.3.)

A 3.5.4 Schulz, R. E. Job aid for validating instruction (HumRRO Draft Manual). Alexandria, VA: Human Resources Research Organization, October 1978.

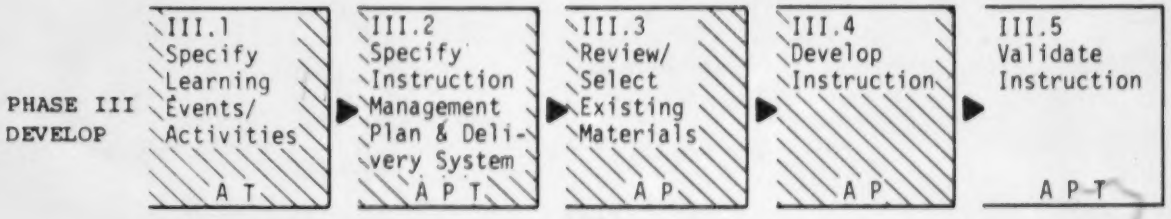
Schulz provides a detailed authoring aid which steps the trainee through validation procedures identified by the ISD model.

P 3.5.5 Wulfeck, W. H., Ellis, J. A., Richards, R. E., Wood, N. E., & Merrill, M. D. The instructional quality inventory: I. Introduction and overview (Special Report No. 79-3). San Diego, CA: Navy Personnel Research and Development Center, November 1978.

The IQI is a quality control procedure designed to evaluate instructional objectives, tests and materials designed by the ISD method (P 3.3.1, P 5.3.1).

Status

Procedures, techniques, and authoring aids following the ISD model (Schulz, 1978; Wulfeck et al., 1978) exist for pilot testing newly developed instructional materials.



Purpose of Block IV.1 Implement Instructional Management Plan

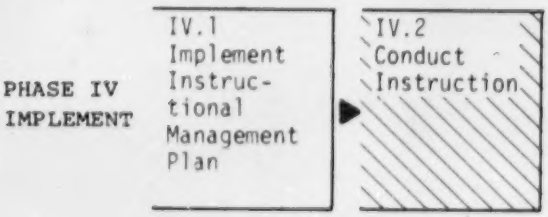
To initiate plan which specifies trainees, learning activities, and resources (this is achieved by making and completing checklists).

References

The authors could identify no references for this block.

Status

Some references included in Block III.2 discuss implementation. An authoring aid would be useful for activities such as the development of checklist used during implementation.



Purpose of Block IV.2 Conduct Instruction

For the instructor to initiate the instruction using the setting, methods and media specified by the management plan.

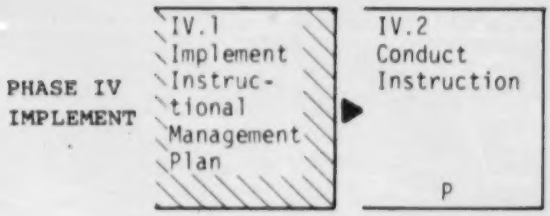
References

P 4.2.1 Hillelsohn, M. J. Implementation of CBLM. Teaching with computers: A guide to creating instruction for computer presentation. Unpublished manuscript, 1979. (Available from Human Resources Research Organization, Alexandria, VA.)

Hillelsohn provides a procedure for initiating computer-based instruction by detailing the tasks of the course administrator.

Status

The Hillelsohn (1979) procedure would make a useful authoring aid for computer-based instruction. Procedures and authoring aids are needed which focus on the implementation of traditional classroom instruction utilizing a variety of media.



Purpose of Block V.1 Conduct Internal Evaluation

1. To determine student progress.

2. To improve quality of instruction.

These goals are achieved through the collection of data from students, instructors, and supervisors and the evaluation of this data. Data must indicate the relationship between student entry behavior and achievement on the terminal learning objectives. The ISD effort is evaluated as well. The development of the instruction is monitored to see that it is consistent with prescribed ISD procedures.

References

P 5.1.1 Borich, G. D. A systems approach to the evaluation of training. In H. F. O'Neil, Jr. (Ed.), Procedures for instructional systems development. New York: Academic Press, 1979.

Structured decomposition is a program evaluation procedure in which data is collected in each component of a program. Discrepancies observed between planned and actual outcomes are examined.

P 5.1.2 Champagne, A. B. & Klopfer, L. E. Formative evaluation in science curriculum. Journal of Research in Science Teaching, 1974, 11(3), 185-203. (ED 088 718)

A procedure for the formative evaluation of a new science curriculum is presented. Sources of evaluation data considered are the curriculum development plan, student instructional materials, student behaviors with respect to science content, student behaviors in the classroom, the teacher and course marketability.

P 5.1.3 Elsbree, A. R. & Howe, C. An evaluation of training in three acts. Training and Development Journal, 1977, (July), 1-19.

Elsbree and Howe discuss procedures for the evaluation of training which focus on (1) the establishment of the general scope and objectives of the evaluation, (2) the production of a blueprint for conducting the project and (3) obtaining data, interpreting data, and reporting to the client. Flow charts of each of these phases are provided as well as a narrative providing an example specific to Civil Service training.

T 5.1.4 Hall, E. R., Lam, K., & Bellomy, S. Training effectiveness assessment: Volume I, Current military training evaluation programs (TAEG Report No. 39). Orlando, FL: Training Analysis and Evaluation Group, December 1976. (AD A036 517)

Hall, E. R., Rankin, W. C. & Aagard, J. A. Training effectiveness assessment: Volume II, Problems, concepts, and evaluation alternatives (TAEG Report No. 39). Orlando, FL: Training Analysis and Evaluation Group, December 1976. (AD A036 518)

Volume I examines interservice training evaluation efforts. Volume II discusses problems which have been observed in Navy training evaluation efforts. A variety of evaluation techniques are reviewed with guidelines indicating the most appropriate use of each.

P 5.1.5 U.S. Civil Service Commission. Training evaluation: A guide to its planning, development, and use in agency training courses (Pamphlet T-13). Washington, DC: Bureau of Training, U.S. Civil Service Commission, May 1971.

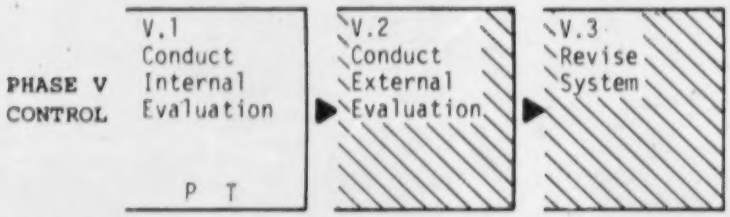
This pamphlet describes a procedure for assessing effectiveness of internally developed and administered training courses.

P 5.1.6 U.S. Civil Service Commission. A process for the evaluation of training. Washington, DC: Training Leadership Division, U.S. Civil Service Commission, April 1978.

This document provides a procedure for formulating and implementing an evaluation plan.

Status

Procedures and techniques exist for student assessment (Champagne & Klopfer, 1974; Hall et al., 1976). Procedures for planning internal evaluation are also available (Borich, 1979; Elsbree & Howe, 1977; U.S. Civil Service Commission, 1971, 1974). Unfortunately authoring aids and procedures which follow the ISD model are unavailable.



Purpose of Block V.2 Conduct External Evaluation

To determine whether trainees meet the needs of the command.

The external evaluation examines survey data of trainees in the field, job performance measures, and evaluation of supervisors.

References

P 5.2.1 Department of the Air Force. Training and evaluation course reviews (ATC Regulation 52-1). Randolph Air Force Base, TX: Headquarters Air Training Command, Department of the Air Force, September 1971.

This document is a regulation which details procedures for internal and external evaluation. The intention of the data collected is to provide feedback for ISD course improvement.

P 5.2.2 Pennell, R., Harris, D., Schwille, J. Appraisal of Air Force training course field evaluation system (AFHRL-TR-76-63). Lowry Air Force Base, CO: Technical Training Division, Air Force Human Resources Laboratory, October 1976. (AD A035 641)

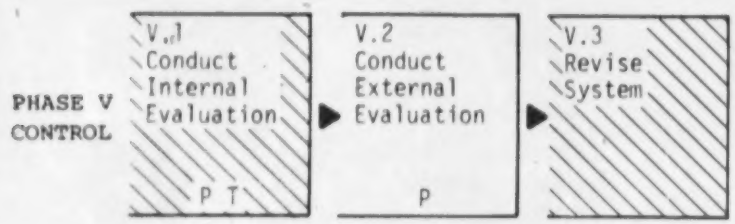
Pennell et al. examined the Air Force field evaluation procedure with the intention of improving data analysis and reporting. Recommendations were made which focused on the design of the evaluation instrument and frequency of evaluations.

P 5.2.3 Walker, R. A. Post-hoc evaluation of S-3A instructional systems development. San Diego: Courseware, Inc., 1978.

Walker reports on procedures used to evaluate a training course for an anti-submarine warfare aircraft (S-3A) developed by an ISD approach.

Status

Procedures exist for conducting an external evaluation for military training courses. Authoring aids are needed which follow the ISD model.



Purpose of Block V.3 Revise System

To revise the system based on internal and external evaluation reports and changes in instructional needs due to new doctrine, procedures, or weapons systems.

References

P 5.3.1 Ellis, J. A., Wulfeck, W. H., Merrill, M. D., Richards, R. E., Schmidt, R. V. & Wood, N. D. Interim training manual for the instructional quality inventory (NPRDC TN 78-5). San Diego, CA: Navy Personnel Research and Development Center, February 1978.

The Instructional Quality Inventory is an analysis procedure for evaluating and revising instructional materials. This document, which is currently undergoing revision, is a manual designed to train instructional developers in the use of the IQI (P 3.3.1, P 3.4.11).

T 5.3.2 Gropper, G. L. Diagnosis and revision in the development of instructional materials. Englewood Cliffs, NJ: Educational Technology Publications, 1975.

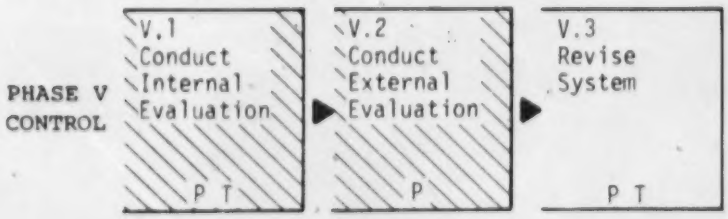
Gropper reviews types of student failure and program failure which indicate needs for program revision.

T 5.3.3 Rayner, G. T. An empirical study of a methodology for the revision of systematically designed educational materials (CAI Center Tech Report No. 24). Tallahassee, FL: Florida State University, Marcy 1972. (ED 067 877)

Rayner has designed a model for revising the content and procedures of instruction which incorporates instructional objectives, diagnostic tests, prescriptions, and posttests. The model has been successfully tested on health education courses.

Status

A procedure and technique exist for revising a course based on internal and external evaluation data. An authoring aid (Ellis et al., 1978; P 3.4.11) following the ISD model is in preparation. More procedures and authoring aids would be valuable.



CONCLUSIONS

The following section presents references for authoring systems. The intent of these systems is to provide authoring aids or procedures for all steps of the instructional systems design process. A summary is then provided indicating the availability of authoring aids, procedures, and techniques by phase. Finally suggestions for research and development are made in light of the availability of such materials as noted in the summary.

Authoring Systems

Several systems have been developed or are in development which guide an author through complete phases of an instructional development effort. The systems use a variety of media for delivery and generally incorporate the procedures identified by the ISD model.

Control Data Corporation. Computer resource for effective author training in education (CREATE). Minneapolis, MN: Control Data Corporation, 1978.

CREATE is a curriculum for the development of individualized instruction. A variety of media is used to deliver the course including printed text, videotapes, and CAI. The student author is expected to take the course at a learning center so that all media are readily accessible. The curriculum is modularized so that a program of instruction can be designed for each student.

Department of the Air Force. Training handbook for designers of instructional systems (AFP 50-58). Washington, DC: Department of the Air Force, July 1978.

The Air Force training handbook is a set of authoring aids or procedures detailing an instructional systems development model (AFM 50-2). The major steps of the model are: (1) Analyze Systems Requirements; (2) Define Education or Training Requirements; (3) Develop Objectives and Tests; (4) Plan, Develop, and Validate Instruction; and (5) Conduct and Evaluate Instruction. Instructional developers receive guidance in filling out a series of forms for each step of the ISD process.

Hughes, J., O'Neal, A. F., Kearsley, G., O'Neal, H., Fee, M., Rodi, L., & Hermanns, J. Functional specifications to computer aided training systems development and management (CATSDM) support functions (Tech. Report NAVTRAEQUIPCEN 71-C-0018-1), Orlando, FL: Naval Training and Equipment Center, July 1978.

This reference is a specification for a system of computer programs which manages the total ISD process.

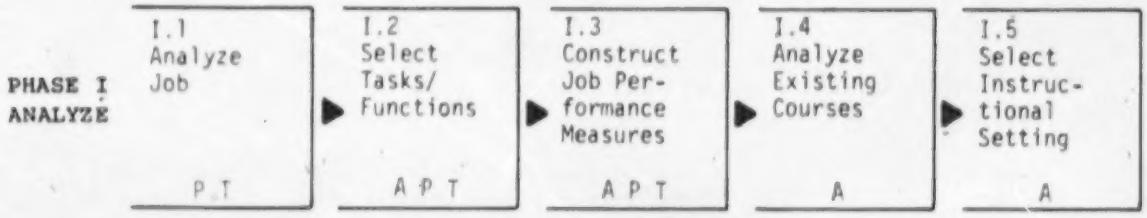
> Harris, W. P. An authoring system for on-the-job environments. In H. F. O'Neil, Jr. (Ed.), Issues in instructional systems development. New York: Academic Press, 1979.

The Lincoln Laboratory has devised and field tested a system which enables subject matter experts (SMEs) to create computer-deliverable on-the-job training materials. A Lincoln Terminal System was used to deliver the authoring system. The authoring training lessons were created to guide SMEs through the development of CAI materials without providing instructional development theories.

Status

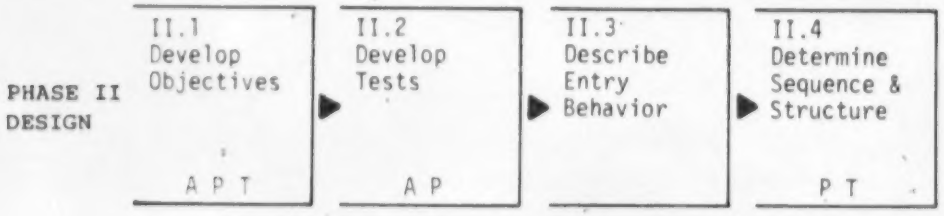
A system incorporating all blocks of the ISD model is currently unavailable. The Department of the Air Force Training Handbook (1978) is not directly applicable for Army training developers because of its reliance upon Air Force terminology. The Hughes et al. (1978) authoring support system will be most appropriate to this need once it has been developed. Throughout the prior reference section a series of authoring aids prepared by Schulz (Human Resources Research Organization) have been noted. The aids have been developed under contract to the U.S. Army Research Institute for Behavioral and Social Sciences. By October of 1979 thirteen aids covering Phases I, II, and III (excluding Block I.1) will have been developed and evaluated.

Summary of Availability of Authoring Materials by ISD Phase



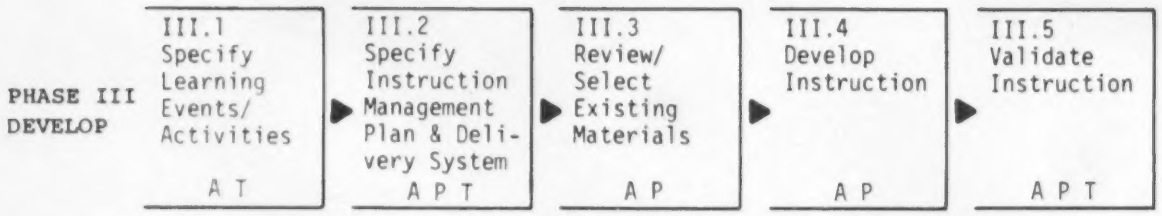
Job information is collected and analyzed during Phase I. Tasks are identified for training and tests are developed to show job mastery. An analysis of existing courses is made to determine the availability of courses designed to teach the tasks selected for training. The best match between selected tasks and instructional setting is then determined.

Schulz (A 1.2.3, A 1.3.3, A 1.4.1, A 1.5.1) has devised authoring aids for all of the above activities except job analysis. The Schulz aids provide forms to be filled out covering each procedure identified by the ISD model. Although an authoring aid does not exist for Block I.1-Analyze Job, there are procedures available which could be converted to an authoring aid format (Training and Doctrine Command, P 1.1.11).



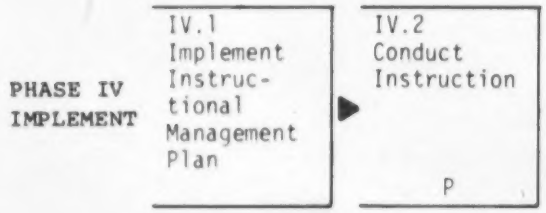
The Design phase utilizes the job analysis data produced in Phase I. Learning objectives are devised for each task and test items are produced for each learning objective. Pretests are developed to examine the trainees' knowledge prior to instruction so that the level of instruction is appropriate to the needs of its users. An analysis of the learning objectives is made to determine the most appropriate order for the instructional activities.

Authoring aids exist for the development of objectives (Schulz, A 2.1.4), and test items (Roid & Haladyna, A 2.2.4; Schulz, A 2.2.5; Swezey & Pearlstein, A 2.2.6). Procedures are available for sequencing instruction by creating learning hierarchies (Dansereau et al., P 2.4.4, T 2.4.5; Durell, P 2.4.6) but an authoring aid is not available. Neither techniques, procedures, nor authoring aids are available for Block II.3-Describe Entry Behavior.



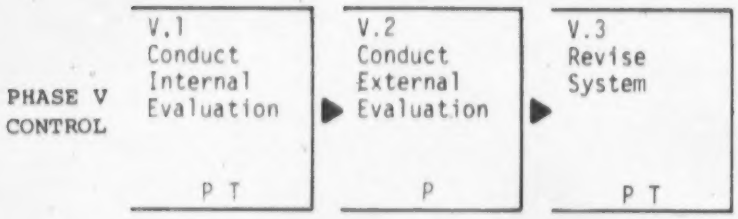
During Phase III the learning objectives are classified so that the optimal instructional events to produce learning can be identified. A plan is made which specifies the allocation of training personnel, instructional materials and plant requirements for the conduct of instruction. At this time a determination of the most appropriate instructional delivery system (considering a variety of media) is made. A review of instructional materials is made to determine whether existing instruction meets the requirements of the learning objectives. New instruction is developed for objectives not taught by existing materials. A pilot test is then conducted to try out the instruction.

Phase III is the best developed in terms of the availability of authoring aids for print and audio-visual materials. At least one aid is available for each block. Authoring aids are needed however for the development of computer-based instructional materials. A considerable number of procedures exist for media selection and the development of instruction.



The plan which specifies the trainees, learning activities, and physical resources is initiated during Phase IV. The instructor receives an orientation to the course, conducts the instruction, and records student data.

Authoring aids are unavailable for both blocks of Phase IV. Procedures were also unavailable for Block IV.1. The single procedure identified for Block IV.2 could be converted to an authoring aid; however, its scope is limited to computer-based instruction.



During Phase V the data collected about student performance are evaluated to reveal deficiencies in the instruction. On-the-job performance of trainees is also of interest to determine whether the instruction meets the needs of the Command. Finally the internal and external evaluation data are summarized to provide input for revisions to be made on the completed instructional system.

Authoring aids are unavailable for the evaluation phase. A variety of procedures exist for conducting internal and external evaluations but none use the activities and terminology specified in the ISD model. The procedure for revising instruction devised by Ellis et al. (P 5.3.1) will evolve into an authoring aid directly applicable to Block V.3.

Summary and Plans for Research and Development

In Figure 2 the availability of authoring aids for the complete ISD model is summarized. Briefly, an authoring aid is needed for Block I.1-Analyze Job. Procedures exist for job analysis so an authoring aid could be readily developed. Block II.3 would require a greater effort because procedures would need to be developed as well. Phase III-DEVELOP has a sufficient number of authoring aids and procedures to recommend no further effort for print materials. However, authors aids are required for computer-based instructional materials. Phases IV-IMPLEMENT and V-CONTROL need authoring aid development. Phase V would be a higher priority than Phase IV because quality control is essential to an instructional design effort.

Three concluding comments regarding this state-of-the-art assessment of Instructional Systems Development are salient. First, there exists a considerable lack of information on the best ways of managing the instructional systems development process. Second, the interrelationship between the ISD process and instructional strategies is an important one, yet the knowledge and technology base for understanding this relationship is lacking. An ongoing state-of-the-art assessment in instructional strategies will address this issue. Third, although most persons in the field believe that the instructional system development process is an expensive one, there is a lack of accurate detailed ISD cost data.

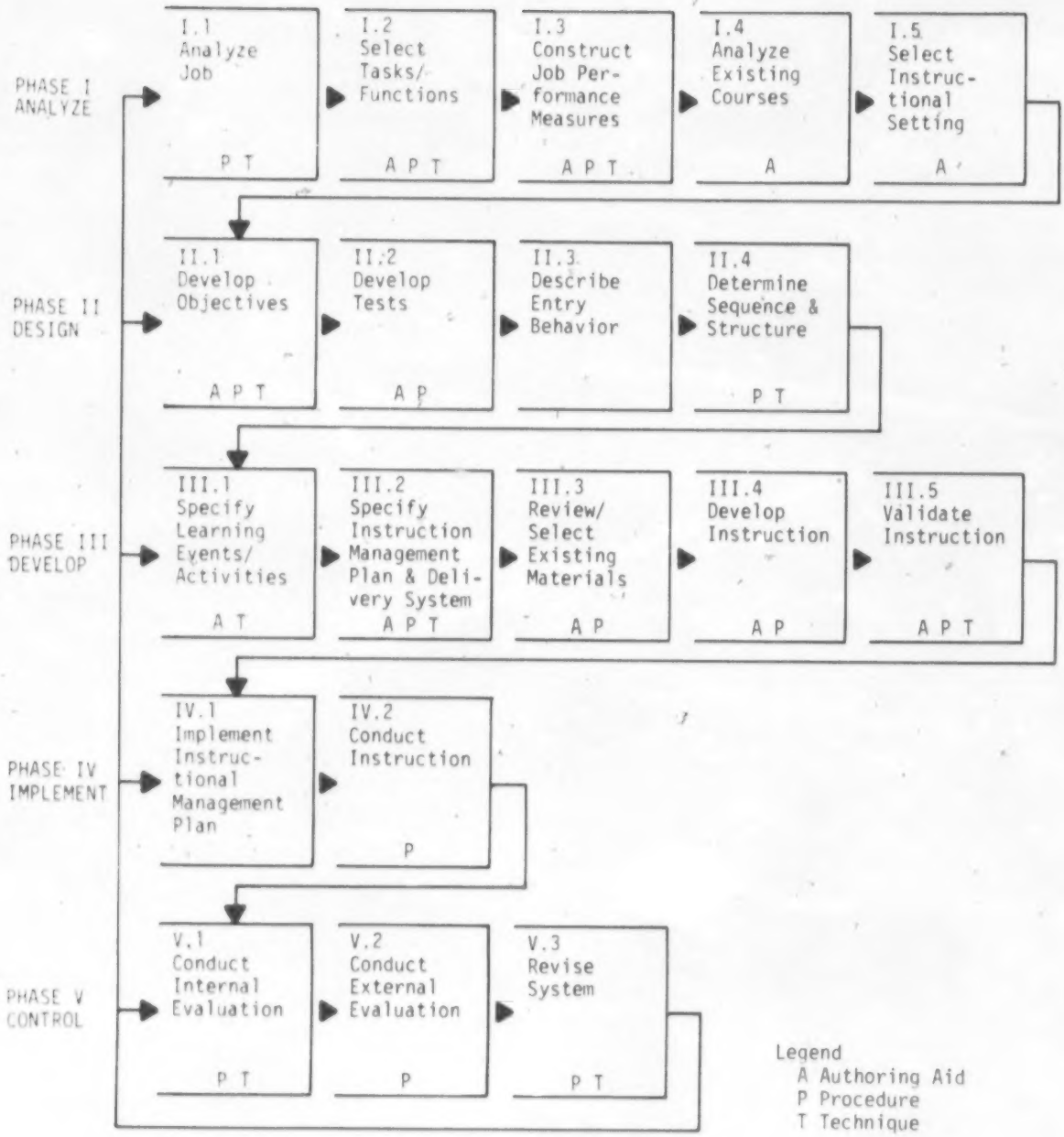


Figure 2. Availability of authoring materials for the ISD model.

The final product of this research and development effort is viewed as an integrated instructional system composed of a series of field tested self-paced modules. The modules will be ISD authoring aids, an author management system, and a computer-based instruction course to teach how to use both the job aids and management system. The curriculum will be designed so that extensive resources, instructor personnel or facility support will not be required. The modules will be available in the form of audio-visual materials, books, and documented computer programs. Evaluation data regarding its cost-effectiveness will also be available.